MILES LECTURE II

THE CAPTIVITY OF SCIENCE

Science as Exploiter and Science for War

(Paul Gregorios)

The era and culture which have brought Asian civilisation under western intellectual and spiritual domination have modern science/technology as their most powerful instrument is being used today in the world can illuminate the nature of Asian captivity and show us the way to emancipation.

We shall look at the relation between science and militarism but before that let us see how the scientific/technological enterprise in the world is a captive of the unjust economic structures of market economy imperialism.

A. Science, Society and Liberation

Modern science has become a 'Sacred Law', perhaps more so for Asian intellectuals than for Westerners who have lived with it much longer. To question Science and its ultimate authority is to risk one's standing in the academic community.

The west has begun to question the hegemony of science, only after science/technology provided affluence for the majority. We in Asia, (especially outside Japan), an Asia where affluence for the majority is still only a pious dream, have to look to modern science/technology to make that dream come true for us.

We have in India a project spensored by the U.N. University on " alternative science". Ashis Nandy is one of the leading spokesmen today of the possibility of another kind of science than western science. He gives us examples of "ethno-sciences" the Navaho plant classifications and Indian bio-feed-back oriented Yoga systems; Acupuncture would clearly be an alternate science, which is now accepted by modern science. Ashis Nandy argues that western science is today a captive of the establishment, determined to be used for exploitation and cultural

destructiveness, and that Asia should develop an alternative science, without the aggressive-exploitative character of western science.

This captivity of science is threefold - to the corporations, to the military establishment, and to a decadent culture unable to provide orientation for science.

Science/technology has today become a large vested interest captured by the military - industrial - banking complex that runs the market economy world. And that captivity has been able to force a major part of socialist science also to become captive of the military establishment.

Pure science, such as produced the Theory of Relativity and Quantum Mechanics, is a rarity these days. Not even 5% of the total investment in science is dedicated to disinterested investigation of reality. More than 95% of it is geared to profit and war. Half a million scientists all over the world are today engaged in military research - i.e., in finding out more effective ways of destroying others and ourself. One-third of all scientific research is controlled and financed by the military, and one half by corporations; almost all the leading universities of the developed world look to the military or the corporations for finding their scientific research projects.

The Corporations control half at least of total scientific research in the developed market economy countries. They know where the market is - in food, health, 'security', clothing, shelter, communications, energy, know-how, transport and entertainment. These are all necessary for the human being, and scientific research alone can help the world to feed itself properly, to be in good health, to have peace, to be decently clothed, to live under a proper roof, to communicate with each other, to use leisure creatively and to have the energy and knowledge to do all this effectively. These are basic needs, and science/technology should be geared to meeting these basic needs.

The tragedy is that the interest of the military-industrial-banking Complex is not meeting these basic needs of all the people, but rather profit and power for the few. The MIB Complex will use human basic needs to exploit and enslave the people in need.

fact. I wish I had tome to speak to you in detail about the problem of " seed patenting" by which the companies seek to make all food production dependent on them. Agriculture is being fast industrialized, and one consequence in market economy countries is the domination of the agricultural sector also by the M.I.B. (military-industrial-banking complex). They can control the price of seeds, fertilizer and agricultural technology. The same is true of medical facilities which have already been priced well beyond the capacity of the ordinary person even in developed market economies.

Science has to be delivered from its captivity to the M.I.B., if it is to serve the interests of humanity. At the moment there is no alternative financier who can under-write scientific research in the non-socialist world, since the state itself is a function of the M.I.B.

Science-technology has become the major instrument of exploitation in the non-Capitalist world. This was brought out clearly by a UNESCO study undertaken in 1975. They made a study of Research and Development in Science/Technology in 150 countries (nearly all except China) based on 1974 statistics. The results are shocking. Global expenditure on Research and Development was US $ 101,785 million - say 102 billion. Of this amount, 2.6 per cent was spent in the developing countries and 97.4% in the developed countries - both market economy and centrally planned.

There were 2,978,204 scientists and engineers with Post-graduate degrees engaged in Research and Development in the world. Of these nearly 3 million researchers, only 6.1% was in the developing countries, and 93.9% in the developed countries.

Those who finance Science/Technology research also control it. In ten years, the money spent on R and D has already trebled. But the industrially less developed countries, with two-thirds of the world's population do not even manage to keep up with their 2.6% of the total. The big U.N. Conference on Science and Technology for Development (Vienna, 1979) spent 18 days and 25 million dollars discussing this problem. Most of the time was spent on empty speeches. The negotiation behind the scenes was between two groups - the more than 100 developing countries as a block, and the developed market economy countries as another bloc, with the socialist countries nearly neutral, though sympathising with the non-aligned. They agreed that a fund should be created to help the developing countries with Science and Technology Research. They disagreed on how much money the fund should have. The developing countries demanded a two billion dollar fund for 10 years. The developed countries proposed 200 million but subject to approval by their governments. The final compromise was $ 250 million for ten years, but without any commitment. That is about $ 25 million a year. And the gap in 1974 was $ 96,500 millions. Today it is more than $ 200 billion.

So in our present society as science - and - technology develops further, the developed economies will have greater power to enslave and exploit the developing economies. That is why there is no emancipation from Asian captivity unless we liberate science and technology from the grip of the M.I.B.

This is the aspect of our captivity to which Ashis Nandy makes but scant reference. Neither does Fritjof Capra or other western writers dwell on this at length. Capra in his Turning Point (sub-title: Science, Society and the Rising Culture, 1982 Fontana Paperback, 1983) speaks about the need for a paradigm change in science as a whole and its perception of reality. His argument is that the present over-all mechanical paradigm leads to major distortions in our understanding of reality. Now we need a paradigm that does justice not only to quantum theory and relativity theory, but also to the emerging and dynamic or flowing perception of reality. That will lead to a global

ultural transformation, according to Capra. This it will indeed.

But Capra does not recognize as the main problem the enormous pattern of international political-economic injustice within which science develops. He refers to Third World objections to importing the science and technology and related problems of the West (P. 463). But his insensitivity to the gruesomeness of international economic injustice makes his analysis less useful to Asians. Asians have a double task - to liberate science/technology from unjust economic structures, and to develop an alternative science.

B. War Worries.

Two problems have clearly emerged in the area of war and the arms race which should be of central interest to Asians in their struggle for emancipation: (a) the Reagan Administration's Strategic Defence Initiative (Star Wars) and (b) the new Scientific Consensus on the ecological Consequences of even a limited nuclear war (Nuclear Winter).

These two figures do not need detailed treatment for this audience, which is already quite familiar with their main elements.

The foundation of S.D.I. and the coming into power of Ronald Reagan took place around the same time - in 1981.

General Daniel Graham (retired) and the near fascist scientist Edward Teller, with the Rand Corporation, a major enemy of humanity, were the main architects. The idea had been shaped befo Reagan came to power - the idea of the "High Frontier", but the monograph with that title became available around the time of Reagan's access to the most powerful seat in the world.

The idea is simple - a Maginot Line in space which the enemy cannot break through - the "inviolable" high frontier of an "absolutely reliable" space-based anti-missile defence system.

It was only in 1983 March, two years after accession that Reagan made his "star wars" speech on S.D.I. Many Americans were thrilled by it. It was written in the best rhetorical

language and delivered with impeccable histrionic training.

The speech-writer knew the psychology of the American people - especially of the waive and unsophisticated among them. The American people do not like nuclear weapons, especially if they are too close to them. So the speech thundered ; "destroy nuclear weapons - destroy them away from us - in space, from space! keep the earth, especially our land, free from all nuclear war". The rhetoric sugar-coated the war mongering as longing for peace - the peaceful "space shield" that will protect American civilisation. No more M.A.D. - mutually assured destruction but AUSS - Assured U.S. Survival.

So went the rhetoric of that Star Wars speech.. Only later somebody suggested that the U should be dropped from AUSS. What are the arguments for S.D.I.? Mainly three - (a) it is clean, and keeps the earth free from nuclear war; (b) it is defence , not offence, and (c) it is to be welcomed, because it renders nuclear weapons obsolete. Wat are the facts?

(a) The strategy is not reliable, first because it is powerless against cruise and other missiles which travel through the earth's atmosphere and can deliver nuclear warheads from sub-marines and planes.

(b) The strategy is not reliable, for even if the launch is entirely through space, the defence strategy cannot be effective - since maximum effectiveness which can be technologically achieved is about 90%. Even if the system is 95% efficient, in case of a massive 1000 missile attack, the 50 missiles that will certainly get through the barrier are sufficient to destroy a country and destabilise the world's ecology and life system.

(c) The strategy destabilizes the world also by giving one nation military superiority over others, and making others totally at the mercy of one nation. This fascism cannot be allowed.

(d) If the U.S. resorts to a space-based military system, the USSR is not going to sit idle. In fact they are not sitting idle. They have already developed Cruise missiles which can

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escape the space shield. They will develop offensive weapons which can destroy the space shield. The vaunted security shield will not last long and will soon become obsolete white elephant hanging over our heads in space.

(e) A space war would not be so clean. Even if missiles are destroyed in lower space, damage to the zone shield, and radiational and climatic hazards to humans can be immense and intolerable.

(f) S.D.I. is forbiddingly expensive - even for the U.S.A. In 1985-89 $27 billion has been allotted for a research programme for developing a space-based defence system. If two billions of that amount could be set apart for humanely useful scientific/technological research in Two-third world countries, this could substantially help alleviate poverty and ill health in the world.

Building the system would cost at least $ 500 billion. The U.S. is now heavily in debt and lower income groups are suffering. Spending 500 billion dollars on S.D.I. means more profit for the corporations at the tax-payer's expense, rendering the common man poorer. M.A.D. is being replaced by clay-headed, raising, abnormal, zany yankeeism or CRAZY. It will drive the world crazy. Humanity cannot permit such fascist madness; it is assuredly self-destructive for all humanity.

We are well into the space-based war system now. On January 25th 1984 Reagan announced plans to build a permanent orbital station - Columbus, costing 8 billion dollars, the first constituent elements to be assembled in space by 1992. It will be a command and communication centre as well as a space-weapon assembly plant. There is the idea that space-based industry can also be developed there.

The Russians have already followed suit - they are also working on a space station, as well as the technology of disrupting other space stations. In February 1985 President Mitterand of France called for a manned military orbital station for West Europeans. If other countries would not cooperate, France would go it alone.

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Fashioning the Future—Some Complex Issues in Science, Philosophy and Culture

Paul Gregorios

SCIENCE has for long been the best friend of humanity. It's achievements are truly enormous—putting a man on the moon and breaking the genetic code are two of the more dramatic feats of science.

It is to be expected that modern science and the technology based on it, by virtue of its versatility and vitality, will raise some major questions for humanity. What is strange, however, is that many of these questions cannot be answered by science itself.

In this paper, we shall pick up three clusters of such questions all of which have some ethical import: (*a*) two examples of decision-making in science and technology; (*b*) the problem of the kind of society in which science develops; and (*c*) science as a problematic human instrument for fashioning the future. There seems to be no fully scientific method by which we can arrive at a satisfactory answer to many of these questions. My Marxist friends may perhaps want to argue that science itself is capable of dealing with all of these problems: I would be interested in such arguments in the cases that are set forth as examples.

Decision-making in Science and Technology

Peaceful Uses of Nuclear Energy

Let us take two examples to illustrate this cluster of problems: the peaceful use of nuclear energy, and genetic engineering, or the manipulation of living organisms. Both, as we shall soon see, are really live issues for us in India, though the general public is only just beginning to awaken to the importance of these questions.

India has embarked on a determined programme for the peaceful uses of nuclear energy. There are two aspects to this. First, that of peaceful nuclear explosions, which we shall not discuss here. What we

did in Pokhran on 18 May 1974, was simply to dig an L-shaped tunnel, and to put a 12-kiloton plutonium device into an underground chamber at a depth of 107 metres. The device went critical according to plan and exploded, raising a dome of earth 170 metres in diameter and 34 metres in height; the dome slapped down in less than 3 seconds producing a crater 10 metres deep and less than 100 metres in diameter. The experiment cost Rs 32 lakhs. This technology can be used in the future for building harbours, digging deep canals or underground water reservoirs; to seal off burning natural gas, etc. There are connected problems which we will not go into here.

What we need to discuss are problems raised by our nuclear power projects in Tarapur, Rana Pratap Garh, Kalpakkam and Narora. Only in Tarapur do we use enriched uranium as fuel and therefore have to depend on the Americans with all the attendant problems that Carter and Morarji once discussed in that famous private conversation some years ago—problems which have not yet been settled. In the Rajasthan, Madras and U.P. projects we use natural Uranium[1], enriched[2] by 'moderators', or materials with light nuclei (like ordinary water, or heavy water in which the hydrogen is deuterium; i.e., hydrogen with one proton and one neutron in its nucleus, rather than the single neutron nucleus of ordinary hydrogen) which can absorb fast neutrons emitted by radioactive materials and slow them down to thermal energy which is what is needed in reactors.

Now what is the problem? To put it briefly: the whole fuel cycle is full of problems, mainly radiation hazards. The mining of uranium ore, production of the yellow cake, disposal of the tailings left after production of the yellow cake (usually about 100 times as voluminous as the cake itself), the liquid waste from the caking process—all these are full of radioactive hazards. Many of the buildings in Colorado are still dangerous, because their basements are filled with trailings-sand. Just the ordinary functioning of a nuclear reactor leads to a lot of radioactivity escaping into the biosphere. Chief among these, argon-41, fortunately has a half-life of only some two hours. Impurities in the cladding, around the fuel rod, may also lead to radiation leaks. Iodine-131, often leaked by reactors and released in large quantities by the fall-out from atmospheric test explosions, is exceedingly dangerous. Its half-life is eight days; enough to be absorbed by the grass and so into cows and through cows' milk into humans. And hence the risk of blood cancer in both children and adults. Dr. E. Sternglass, Professor of Radiation Physics at the University of Pittsburgh, read a paper in 1969 at a symposium sponsored by the US Atomic Energy Commission, which stated that some 400,000 infants less than a year old, had probably died as a result of nuclear fall-out between 1950 and 1965.[3]

The used fuel-rods are the most dangerous; they have to be disposed of or re-processed. At the British Windscale nuclear reactor, about 600

cubic metres of highly radioactive waste had been stored by the end of 1974. In the USA, the Hanford Reservation in Washington State had 250,000 cubic metres of high-level radioactive waste stored in ordinary steel tanks. More than a dozen leaks have already occurred. A leak in the large tank (No. 106:T) released approximately 435,000 litres of highly radioactive liquid into the earth before the Atomic Energy Commission (AEC) and its subcontractors decided to empty the tank into other tanks. This liquid contained 40,000 curies of Caesium-137, 14,000 curies of Strontium-90, as well as some plutonium. Most of this would have already reached ground-water levels and contaminated the water people use.

Even without leaks developing, some of these tanks, which are made of concrete with an inner lining of steel or glass, can last only a few dozen years. Strontium-90 has a half-life of 28 years.[4] This means that Strontium remains dangerously radioactive for at least 300 years. Plutonium has a half-life of 24,400 years.

New techniques of leak-proof storing have been devised in the last few years. But waste management continues to be a problem, though experts, including our own in India, are loathe to admit this. Whatever the experts may say, people know enough about the accidents that took place on 3-Mile Island in Pennsylvania (two in 1979 and one in 1980), not to fully trust the experts.

If a future has to be fashioned for mankind, one which is not hellish, we will have to do something about nuclear testing, nuclear arms manufacture and its use, and even about the use of nuclear power for peaceful purposes. To my knowledge, no scientific demonstration has proved that the increase in the incidence of cancer in our time is not caused, at least in part, by nuclear fallout and leaks. For the educated layman such an investigation seems necessary, though it is difficult to devise conclusive tests.

In India we have marched boldly forward in the construction of nuclear reactors, leaving it largely to the experts to worry about the ensuing hazards. There has been no public debate; nor a significant nuclear protest movement. The people are largely uninformed about the hazards of reactor accidents and of fuel waste-disposal. We know little about the huge Windscale accident in the UK where one plant burned down, another had to be closed, and both entombed. What do we know about the military nuclear power plant accident in Idaho in 1961, when the whole plant exploded releasing lethal levels of radioactivity, killing instantly several Americans? Or about the accident at the Enrico Fermi Plant in Detroit in 1963 which led to its shut down?

Why did Switzerland shut down its Lucens reactor in 1969, when operations were at full steam for only a few months? The answer is: because of a major accident in the cooling system.

What happened at the West German power station of Wuergassen on

12 April 1972? Again, a valve failure in the cooling system caused an accident which led to its closure.

Someone should collect the nuclear folklore of the last two decades, in order that we may better understand why there is a virtual nuclear power moratorium in the USA and Sweden, and also in order to see how we, in India, are fashioning our own future.

Someone should also tell us more about Plutonium (P^{239}), the new-made element, which so far as we know does not exist in nature. It was first created by Glenn Seaborg and his colleagues around 1940 at the University of California. Today P^{239} is everywere, used or produced in reactors and nuclear weapons. The Rocky Flats fire in Colorado (1969) caused by the self-ignition of two tons plutonium in Building 776-777 has made people very wary. The immediate loss was estimated at $ 65 million. Plutonium had been released into the surrounding air, earth and water. One microgram of plutonium entering the human lung can cause lung cancer. Two tons of plutonium is enough to kill two billion of the world's four billon people, or half the world's population.

This raises three basic questions:

1. Do we have the right to play with such highly toxic materials which may endanger the health of people all over world now and for many generations to come?
2. Are we taking the option for using nuclear energy after due consideration of all the factors involved?
3. Do we leave such matters to the experts, or should the public be directly and actively involved in informed decision-making?

Can Science answer these questions?

Genetic Mutation

The second example that I would like to offer in the problem of decision making in science concerns genetic engineering. Ever since 1953 when James Watson and Francis Crick gave us the structural analysis of the compounds which form DNA (the master molecule in most genes), and Nobel Laureate Har Gobind Khorana created a biologically active synthetic gene, humanity has been confronted with enormous power-the power to alter the basic structure of all living beings.

It is this capacity for gene mutation which gave us the green revolution with its high-yield variety of seeds. It is this technology which led to the interesting case of Anand Chakraborty developing an oil-eating bacterium for the General Electric Company in the US. A patent was then applied for in 1972; but this has been contested in the US courts for the last eight years. It was only on 16 June 1980, that the US Supreme Court ruled by a majority of five against four, that man-made organisms like bacteria can be patented.

In principle, it is possible to produce in the laboratory a bacterium

against which humanity has no resistance. You can then patent it under some pretext, you can store it and later use it for blackmail, sabotage and so on.

In the USA plant seeds can also be patented. Seed companies have been creating new high-yield or disease-resisting seed varieties by genetic mutation. In Britiain, for example, if a seed company has a plot of high-yield tomatoes, then, people living in the neighbourhood are forbidden by law to grow any other variety of tomato in their back-yards—ostensibly to protect the seed company's tomatoes from miscegenation. The fine for growing an outlawed variety of tomatoes can be as high as £ 400!

Biologist Garrison Wilkes in an article published in the *Bulletin of Atomic Scientists* (1977) expressed the fear that traditional varieties of vegetable and foodgrains may disappear through lack of use. Dr. Erna Bennett of the FAO in Rome also estimates that by 1991 "fully three-quarters of all the vegetable varieties now grown in Europe will be extinct due to the attempt to enforce patenting laws." More recently, *The Washington Post* wrote an editorial on the 'Seeds of Trouble' which said that farmers around the world are planting fewer and fewer varieties of crop. This decrease in genetic diversity may make crops more vulnerable to pests as well as to climatic changes and we may, as a result, face catastrophic famines in the future.

What is more worrying is that the big transnationals are buying up the seed companies. Soon, companies such as Union Carbide, Shell, Pfizer, Ciba-Geigy, Purex, Upjohn, Sandoz, etc., may have a virtual monopoly on plant seeds.

These are all problems which scientists cannot solve by themselves. We cannot fashion the future unless ordinary people like us can begin to inform ourselves and insist that decisions taken nationally, as well as internationally, are conducive to human justice and human freedom.

Science and Society

A UNESCO study estimated that, in 1974, global expenditure on Research and Development amounted to $ 101,785 million of, which only 2.6 per cent was spent in the developing countries, while 97.4 per cent was spent in the developed countries—North America 35.3 per cent; Europe (excluding the USSR) 30.7 per cent; and the USSR 21.4 per cent. By contrast, South America spent only 0.8 per cent and Africa 0.5 per cent. Of the 2,978,204 scientists and engineers engaged in research, 93.9 per cent were in the developed countries with the USSR leading with 39.3 per cent, Western Europe 23.8 per cent and North America 19.1 per cent. All of Asia, including Japan and China, accounts for only 14.6 per cent of the total.

Science develops in this loaded international science-technology order: those who have, can have more and more. Those who do not, will have less and less. The UN Conference on Science and Technology for Development, held in Vienna in the summer of 1979, failed to propose any real solutions. It could only call for the establishment of a $ 250 million R & D assistance fund for developing countries, to set right a gap of $ 96,500 million per year.

To put it another way: in a society where injustice dominates, science and technology instead of becoming instruments for the eradication of injustice have become efficient tools for further exploitation and a more deep-seated injustice. This is true both internationally and intra-nationally. Science and technology are not automatically and inherently good. If society is badly structured then science can become an enemy of the poor, the powerless and the exploited.

The manipulation of economic theory is another way in which science is used to perpetuate a situation of exploitation-domination. The best recent example is Milton Friedman's book *Free to Choose*. Friedman sees inflation as the central problem of the economy and blames the government for printing too many currency notes. It is a simple theory: when there is more money printed than the value of goods produced, then the currency loses its value, or, prices increase in terms of the value of the currency.

But why does the government print more money? According to Friedman, it does so for three reasons: rapid growth in government spending; government's policy of full employment; and the attempt by the Federal Reserve System to control credit supply by regulating interest rates rather than by curtailing the supply of currency. His solution is equally simple. I quote: "Just as an excessive increase in the quantity of money is the one and only important cause of inflation, so a reduction in the rate of monetary growth is the one and only cure for inflation." Of course, Friedman also admits that cutting down currency supply, and therefore a trimming of all deficit budgets and excessive government spending, will reduce the rate of growth and increase unemployment.

Economic theory, masquerading as science, has a great capacity for hoodwinking not only poor consumers like ourselves, but also the planners of our economy. Our prevailing liberal-scientific economic theories, whether neo-classical or neo-Keynesian, contain ideological assumptions that distort the truth. To cite some points, as a non-economist, I would mention the following:

1. The growth-assumption or the non-growth assumption, i.e., either 'more is better' or 'enough is best' (as in Steady State Economics).
2. The 'invisible hand' theory which makes the assumption—though mitigated by Keynesian recognition of governmental monetary and fiscal action as a necessary regulating factor—that justice need

not be built into economic theory.

3. The 'value-free assumption' that economics can be developed as a science quite independent of politics which is the science of power distribution e.g. the assumption that the important factors are inputs-outputs or prices and wages, or inflation and employment or such value-free measurable entities.
4. The assumption that justice will automatically follow the increase of total production, without worrying too much about the distributional and organizational factors at the production stage.
5. The failure to recognize the fact that organized social labour is itself an epistemological category, powerfully influencing our perception of what is wrong and what needs to be done.

The net result is that we propagate pernicious economic ignorance even among our intellectuals who are trained in economics. Economics as a science then stands in the way of economic planners proposing what is really necessary for a radical alteration of the social and political organization of human activity in order to reduce injustice and promote human welfare.

Economic science becomes, thus, an ideological tool of the exploiting classes; the rest of society is unable to trust its experts.

Science and Culture

The third cluster of issues has to do with the role modern science plays in our approach to reality and in our creation of culture. Modern science has replaced medieval religion not only in Europe, but also to a significant extent in India. Among the educated urban elite of our country, science, or the opinion of reputed scientists, has the power to influence both intellectual and spiritual authority. Especially after the launching of Rohini, the prestige of science has also sky-rocketed, if you will pardon the pun. In very complex issues like nuclear power, or the Silent Valley Project in Kerala, educated people are only too prone to 'leave it to the experts'.

The myth that scientific knowledge is 'proved' and 'objective' has been exploded in the West. Scientific positivism may still be the structure upon which the thinking of many scientists and non-scientists rests. But as an intellectual position it has now been acknowledged by the best minds in the West, to be invalid.

The present 'legitimation crisis', as Peter Weingart put it, in which science finds itself, is largely confined to the non-Marxist West. Marxist philosophy, never having accepted empiricism as an exclusive methodological principle or non-subjective objectivity as the standard for truth, is not affected by the current failure of nerve on the part of Western science.

In the English speaking West, the breakdown of positivism in all its

forms has generated widespread despondency about the attainability of truth and has induced a general lack of confidence in the power of science to be the final arbiter of truth. There is a gnawing despair at the heart of Western civilization, felt only by sensitive people, about the future of a civilization based on the proven, mistaken assumption that science and technology could deal with all possible issues of knowledge and actual operation. Until recently, what was scientifically demonstrated was alone regarded as 'truth'. But today two propositions, expressed by philosophers, seers, poets and literary figures and very seldom by scientists themselves, lie buried in the Western subconscious. These are:

1. Science cannot lead us to the ultimate truth for which we thirst and which alone can give us certainty, stability and security.
2. There seems to be no alternative to our kind of science, for arriving at the meaningful and valid truth, *in our operations on the objective material world.*

This pervasive doubt about the ultimate validity of science is not shared by the Marxist world of scientific and philosophical thought. If there is a largely credible variety of Scientism going, then, one finds it only in the Marxist world. It is credible because it is not, as in Western positivism, obsessed with the ridiculous idea of an objectivity free from any trace of subjectivity. The Marxist philosophy of science has from the start, or at least beginning with Lenin, recognized the element of subjectivity in all knowledge. Marxism only refuted the Hegelian idealist principle, in turn based on Plato, that Consciousness or Ideas alone were real; Engels, for instance, rejected all notions of mentalism or solipsism. The Marxists insisted that the external world 'out there' is not a creation of man's mind: it is 'there'—'objectively'.

The fundamental question in Marxism concerns the relation between the reality of sensations, concepts and ideas which we experience, and the reality that supposedly exists 'out there'. In other words, it concerns the relationship between the subjective experience of reality and the objectively existing reality. In the post-positivistic Western world, the definition of truth provided by Alfred Tarski is regarded as sufficient: given a meta-language or a meta-mathematical set of symbols in which 'propositions' and 'facts' can be denoted by commensurate signs, Truth exists where p=f. In non-technical language this is called the correspondence theory of Truth, one which the Marxists reject. In place of 'correspondence', Marxist epistemology and the Marxist philosophy of science substitute the concept of 'reflection' in order to explain the relation between the content of knowledge and objective reality. 'Knowledge reflects the objects; this means that the subject creates forms of thought that are ultimately determined by the nature, properties and laws of the given object, that is to say the content of knowledge is objective.'[5] Marxism thus defends scientific knowledge as objective

because it is a reflection in man's subjective consciousness of an objective material reality.

This position gives rise to two difficulties: first, it is not scientifically demonstrable; second, it is inconsistent with certain other affirmations of Marxist philosophy.

The problem of undemonstrability arises primarily from the present limits of our knowledge. That range, in terms of magnitude, is of objects of the size of 10^{-14} to 10^{28} cm. That means: one by one million four hundred thousand of one by the billion of a centimeter is our lower limit, while our upper limit is 10^{28} cm or about 13,000 million light years. This is indeed a prodigious range, but it is not infinite.

According to Marxism, material reality is not only self-existent and eternal but also infinite. (Incidentally, religious people say something similar about God.) If reality is infinite and if we know that only a finite part of it (10^{-14} to 10^{28} cm) is now reflected in our consciousness, then, how can we, based on our limited knowledge of this finite range, pronounce judgement on the nature of the whole of reality? In order that it may become intellectually more rigorous, Marxism will have to deal with this question in the future. But for our present perceptions about the ways in which we can fashion the future, this question is important, and cannot wait for a final resolution.

The problem of inconsistency in Marxist thought arises because of the insistence on the one hand, that material reality is infinite and that it is a single law governed system, and on the other, that in this system where all parts interact with each other the speed of such interactions cannot exceed 'C', the speed of light. The fact (if it is one) that, within our range of knowledge, 'C' is *not* exceeded would not by itself be adequate for postulating 'C' as a strict upper limit for the whole of reality. Quite apart from the theory of tachyons (particles that move faster than light), in an infinite system, if its parts are fully to interact, the speed of reaction will also have to be infinite. How otherwise can two infinitely distant parts act and react with each other at a finite speed?

We already find new laws emerging as we go down the range of our knowledge to the sub-atomic level. To isolate 'quarks',* we may have to go down to the scale of 10^{-33}. At present it is beyond our capacity to break-up the sub-atomic particles into such micro-micro-objects. But how can we make laws about the limits of speed in the universe, or about the laws of interaction, which would be valid for the whole range?

If he is honest, the religious person cannot claim to have answers to all these questions. Nor does he want to use the gaps in our knowledge

*'quarks' are hypothetical sub-particles of which all sub-atomic particles could be composed.

in order to legitimize religious belief and practice. What he objects to is the habit of making absolute *scientific* judgments based on very partial knowledge. The honest, religious person does not claim that his understanding of reality is *scientific* in the sense that it is established by the canons of established scientific method. What he would insist upon as his fundamental human right is, simply, that he should not be bull-dozed by any dogmatism that masquerades as scientific certainty.

This insistence by the informed religious person has great relevance to the issue of fashioning a future—a relevance that can only be alluded to here. The concept of a 'secular state', imported from the West, is a historically conditioned one; it arose in the context of a revolt against the religious authority of the medieval Roman Catholic Church which in its time dominated all civil and cultural institutions in Europe. The early positivistic as well as the more recent post-positivistic, or critical-rational approaches to secular reality in Western liberalism, as well as the overly dogmatic ontology of social being in Marxism, are creations of that cultural milieu. While these are useful for us up to a point, they cannot be decisive either for the fashioning of our national future in India or for the kind of contribution India could make to the fashioning of the future of humanity.

The least one can do is to promote conversations at a sufficiently deep, scientific and competent level among proponents of (1) the secular Western liberal view (2) the marxist view and (3) the informed, honest religious view, in order to see how all three proponents, from their different perspectives, can jointly contribute to the fashioning of a future in the process of which they might, perhaps, be refashioned themselves. □

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[1] U^{235} with 92 protons and 143 neutrons in its nucleus, forms about 0.7 per cent in natural Uranium i.e., only 7 out of 1000 nuclei in natural Uranium are fissile.

[2] Enrichment of natural Uranium means increasing the proportion of fissile U^{235} in it—a very expensive process. Uranium enriched to 90 per cent U^{235} is best for bombs. But for nuclear power plants, a much lower degree of enrichment is sufficient. The French have a better technique for commercial fuel enrichment (as distinct from the bomb technology of the USA). There is also the Centrifuge enrichment technique developed by Britain, Germany and the Netherlands together. Even more exciting is the laser enrichment technique now in its final stages of research.

[3] Walter C. Patterson, *Nuclear Power*, Penguin, 1976.

[4] Half-life is the time for radioactive material to lose half of its radioactivity. If a ton of fuel waste has 100,000 curies of Strontium radioactivity, it will be reduced to 50,000 in 28 years, 25,000 in another 28 years, 12,500 in another 28 years, and so on.

[5] USSR Academy of Sciences, *The Fundamentals of Marxist-Leninist Philosophy*, (Moscow: Progress Publishers, 1974), p. 204.

Science Isthmus Lecture N
April 29, 1990

The Gaia Hypothesis

Intro. I am not a scientist. I have not prac
scientific research.

I have great respect for modern science
but modern science is not my religion.
am not bound by its dogmas and tabo

I have looked for a scientific formulation of the Gaia hypothesis. I have not found it. Perhaps Prof. Margulis or Dr. Thompson can tell me where to find it, or even state the hypothesis for me.

I have my own formulation - on page 3 of my paper. It is an unprofessional, metaphoric formulation. I shall be grateful for a better formulation.

I do not think that there is an abstract entity called life. I have put the question about the definition of life in a more manageable form: How is living matter to be distinguished from non-living matter? On the answer to that question will depend the fate of the Gaia Hypothesis. Is the earth living matter, a sin living organism? To answer this second question, we should have an answer to the first question, abou how living matter is different from non-living

I was grateful to Prof. Margulis for her statement that the bacterium is not to be understood in its individual existence; ~~it is~~ Bacteria are a collectivity, a colony, a social formation. ~~It~~ Bacteria acts as a corpus, not as individuals She has opened my eyes to the magnitude of the significance of bacterial action, and of algaeic action in preparing a life-promoting atmosphere, in ~~the~~ promoting the dynamics of earth-crust or plate techtonics, in the formation of oceans and clouds and and water cycles. I have acquired a new respect for bacteria, thanks to Prof. Margulis.

For me the evidence being advanced so far for the Gaia hypothesis does not establish that hypothesis. All it reveals to me is a stochastic element in the process of astral, physico-chemical, and biological evolution.

What is meant by Stochastic Process?
στοχαζειν = bow and arrow practice.
Sir Karl Popper has now moved to a "loaded dice" hypothesis. That chance is not everything. Dice are still being thrown but some of the dice are loaded.

If we accept the Friedman model of a Hot Big Bang - i.e. ~~a~~ zero mass exploding at ~~very~~ infinite high temperature. Of course temperature itself is a measure of the energy of the particles. As mass increased temperature went down. Accordi to Stephen Hawking's A Brief History of Time, / sec after the Big Bang, temperature went down from infinity to 10 billion degrees = 1000 times the temperature at the centre of the sun, thousand times the temperature reached in Hydrogen Bomb explosi Hawking ~~the~~ says: " If the rate of expansion one second after the Big Bang had been smaller by even one part in a thousand trillion, i.e 10^{-15}, the universe would have recollapsed before it reached its present size" (p. 128) I am not competent to check Hawking's statement. But if this is true, then the Stochastic element must have been operal already from the beginning of the Big Bang.

All the present local irregularities in the universe today - e.g. vacuum, dense matter, ~~stars~~, galaxies, stars, planets, Satellites moons, meteors - seemed to have been stochastically planned by the Big Bang itself. Life could not have evolv if these irregularities did not exist in an otherwise (supposedly) homogeneous unive

Neither could life as we know it have evolved if certain universal constants with fixed values had not been so finely adjusted Hawking again tells me that if the electric charge of the electron (a universal constant) had been slightly different, stars either would have been unable to burn hydrogen and helium, or else they would not have exploded, and life as we know it would not have evolved.

I hope you begin to see the reasons for my hesitation about the Gaia Hypothesis. Neither politics nor religion should be blamed for my hesitation. I am a member of the religious establishment. But I do not take umbrage at the caveats thrown by Prof. Margulis against organized religion. I am only worried about the terra-centrism of the Gaia Hypothesis. I do not think there is anything scientific about terra-centrism. If the Gaia Hypothesis presages the birth of a scientific revolution, a paradigm change in Kuhnian terms, I plead that the new paradigm would be prepared to look at the whole universal evolutionary process as life-creating and life-sustaini

For my own mental satisfaction, Gaia is not enough. I would rather go back to Gregory Bateson's description of the biosphere in his Mind and Nature - A Necessary Unity (London, Bantam New Age Books, 1980).

He draws an interesting parallel between the thinking and knowing process on the one hand, and the universal evolutionary process on the other. Both are psycho-somatic processes. Both are stochastic processes. To quote, " The two great stochastic systems are partly in inter-action and partly isolated from each other .... The two fit together into an on-going biosphere that could not endure if either somatic or genetic change were fundamentally different from what it is. The unity of the Combined System is necessary (p 164).

Descartes' Separation of

res cogitans and res extensa

Psycho-Somatic processes - Knowing as bodily change. mind as composite parts interacting. triggered by difference. Jacques Derrida's distinction between difference and differance. Differance as non-substantial, non-local.

12. I would go one step further – to speak about three inter-dependent systems – material – corporeal ~~mental – genetic – life~~ evolution, living – replicating – mutation evolution, and Consciousness – awareness – Cultural evolution. – all three triggered by difference, all three stochastic, all three interconnected. In Teilhard de Chardin's terms Geosphere, biosphere and noosphere.

Fourth Dimension

13. But what originates, sustains, and directs, as well as unites the process?
The transcendent –

Beyond Scientific dogma of Secularism, Causality; mechanism observer-observed dualism – classical-quantum dualism.

I hope Gaia Theorists will look at one more thing among the many disciplines — In the Dorian Sagan and Lynn Margulis paper. it says on page 3. That Gaia is consonant with non-Copenhagen interpretations of quantum mechanical equations and data. If that is true — how do you justify your not non-local ferro centrism?

Knowing as Striving Toward Unity

Ways of Knowing in Science and Other Ways of Knowing.

(Paul Gregorius)

Let me first give expression to my gratitude to the Free University of Amsterdam both for organizing this Conference on Concern about Science, and for inviting me to participate. I believe that a Christian University is an excellent setting in which the issues about science and the future of humanity can be most profitably and creatively discussed, provided our Christian outlook and our scientific attitudes are not too narrow or parochial.

In speaking about ways of Knowing in Science and other ways of Knowing I wish to refer first to five somewhat distinctive approaches to the problems of truth, meaning and Knowledge, in different regions of the ~~West~~ modern North-West world where science is most advanced. Secondly I would like to make some reference to one other cultural tradition, namely that where modern science, though a newcomer, is fairly developed, of my own country. I would then like to say something about the roles of community, tradition and interest in Knowing, and to conclude by indicating certain lines of orientation for future development of human Knowledge and life.

Five Western Approaches

We can here only list these approaches in a general way and not treat them adequately. But I feel that scientists all over the world have a responsibility to supply themselves with the understanding of these issues which their scientific training most likely neglected.

(a) The English-speaking world in general

In a 1970 London Symposium chaired by Karl Popper, the debate between Popper's "cumulative" vision of scientific development and Thomas Kuhn's distinction between "ordinary science" and "scientific revolutions"[1] was focussed. Popper thinks that scientific knowledge grows by an evolutionary process in which scientific theories are advanced as bold "conjectures", which are then subjected to rigorous "refutation"; those theories which survive the critical process finding acceptance within the scientific community; the accepted body of conjectures thus constitutes a cumulative, growing body of scientific knowledge, which then exists objectively, as a "third world" of "objective knowledge" distinct from the "world "out there" and the world in subjective consciousness.

Kuhn's view is that behind theories there are paradigms or structures of understanding which are themselves chosen by the scientific community out of its cultural background for the purpose of understanding. At any given time one or more accepted paradigms serve the scientific community as common basis — Newtonian Mechanics and the Quantum-Relativity paradigm of our century being clear examples. The major part of science

1. See Thomas Kuhn, The Copernican Revolution, New York, 1957 P.T.

ordinary science, most scientific workers seeking to refine or illuminate some one or more aspects of an accepted paradigm, while more speedy advance in scientific knowledge comes through scientific revolutions like the Copernican one.

The ~~R~~ main papers of the Symposium and Kuhn's reply to his critics are published in Criticism and the Growth of Knowledge[3]. I wish to cite only some of its major conclusions. Prof. Lakatos states clearly that the two major assumptions of recent western culture, i.e. that scientific knowledge is non-subjectively objective, and that it is indubitably proved knowledge, are no longer tenable, and with this there is a largely unnoticed foundation collapse in science-based western culture. It is also clear that there is no agreement among scientists as to the demarcation criteria between scientific knowledge and other kinds of knowledge. Even on the nature of scientific methodology, which Lakatos labels "sophisticated methodological falsification" there is no agreement.

The inability of even the philosophy of science to solve the epistemological questions in science has led to a group of scientists at Edinburgh University making the distinction between epistemology and epistemics. Epistemology

3. Alan Musgrave and Imre Lakatos (eds), Cambridge Revised edn, 1976.

What scientists think, is a philosophical game which does not actually help in the progress of science, and falls properly outside science. Epistemics, on the other hand is a scientific activity, in which scientists themselves construct paradigms or models in the light of which the scientific enterprise and activity can be scientifically studied. ~~How~~ Prof Mary Hesse of Cambridge University has, for example, advanced and developed the "Feed-back Controlled Teaching Machine" Model" for the understanding of scientific activity. Scientific theories are like the buttons in a teaching machine., one guesses the right answer to a problem and presses the corresponding button; if the proper panel lights up, then the theory is confirmed; if not other theories have to be tried, but then the ~~errors are fed as well as~~ hits and misses are fed back into the machine, so that more accurate theories can be developed in the "theory formulator" which forms part of the science-machine.

To sum up, the general situation in the English-speaking world can be characterised as follows:

a) most scientists are not interested in the philosophy of science, which had not formed part of their ~~*~~ academic training, and they are not very concerned to reflect philosophically on the nature and dependability of the knowledge yielded by science;

(b) those interested in the philosophy of science know that scientific knowledge is neither proven nor objective, that there is no way in science of logically demonstrating that the world "out there" is as we perceive it in

&c &c. All we know is that we can make certain laws-like statements which describe, explain, and help predict, other conditions remaining unchanged, how external reality behaves or will behave. These constitute useful = operational knowledge and provide humanity with skills to engage in more useful and satisfactory relationships with its environment.

© The old positivistic assumptions like "only scientific knowledge is true knowledge", and "no statement which cannot be verified or falsified by objective criteria can be either true or false", cannot be sustained. The second proposition, for example, cannot be true or false by its own criterion, for it cannot itself be verified or falsified.

(b) Polanyi and Personal knowledge. Michael Polanyi's view of "personal knowledge"[4] as distinct from subjective or objective knowledge, grew up on the English speaking soil, but belongs to a continental ethos. The two major features of this view are (i) the delineation of the knowing process in science or personal relations or faith as one in which creative personal elements of feel and touch and intuition constantly interact with rational reflection and awareness, and (ii) that grasping of patterns, gestalts, or wholes in scientific knowing always includes a shifting of focal attention from the detail to the whole, which then allows one to come back to the detail with a greater sense of illumination.

This view has been more popular among students of theology than among practising scientists. But it is a view which when understood can open some important new doors to ~~understan~~ knowing how we know. His views of focal and distal perception and pattern intaking have important significance for all theories of knowing.

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4. Michael Polanyi, Personal knowledge, Routledge and Kegan Paul, 1958, 2nd Corrected impression, 1962; The Tacit Dimension, Routledge and Kegan Paul, London, 1967

(c) Structuralism in French thought: In France the "dialogue" between Existentialism, neo-Marxism, and Structuralism takes such frequent kaleidoscopic turns that it is difficult to characterise the French view of Knowing in any manageable way. Sartre himself has made radical shifts from his earlier ~~perspective~~ existential perspective of "L'être et le neant" to a new view of "Consciousness and Reality" in which the existential way of knowing is only one strand, the other strands being provided by neo-Marxism and a modified Structuralism. Structuralism itself seems to develop as many varieties as the number of its proponents — Jacques Lacan in narrative structures, Lucien Goldmann in Sociological structures, Claude Levi-Strauss in mythical-anthropological structures, Roland Barthes in literary structures and so on.

The main thrust of structuralism comes from two sources — literary criticism and Cybernetics. Take a piece of poetry. If the poet simply puts down the words of a poem in some random or alphabetical order, the whole thing makes no sense, yields no meaning. It is the particular order, structure, pattern in which the words are put together that creates meaning. In a ~~structured~~ poem, each word has its significance only in terms of its relation to its neighbours and to the total structure.

Here one must make a distinction between the signifying symbol or word

and the signified meaning. The signifying element (le signifiant) can actually be words, markers, facial expressions, pictures, mathematical equations and so on. The signified reality (le signifié) is always meaning or idea or thought.

Scientific knowing, according to the Structuralists, lies in two synchronous processes - i. destructuralisation of the structured, and ii, structuration of the destructured. But this twin process cannot be governed by rules. Like the poet, by an unconscious creative process, the scientist, knowing the individual elements in their detailed relationships to each other and to the structure in which they yield meaning, puts forward a scientific hypothesis, which is his own creation, on to reality. The meaning-structure of idea or thought, created by the algebra of signifying elements (words, pictures, models, symbols), is projected on to the reality-structure. Semeiology[5] (the science of Semeia or symbols or signs) is the major tool in science, but it applies also to poetry, anthropology, history or contemporary culture. Science need not be monochromatic. The one-dimensional world-view of 19th century science from which we need to be liberated.

Man is a meaning-creator, a structure-creator. Knowing is a way of creating structures of meaning. He does not take in nature in the raw. He cooks his food before he eats it. Nature has to be made into culture by transforming it through knowing and changing nature.

5. Roland Barthes, Elements of Semiology, London, 1967; C. Levi-Strauss, Structural Anthropology, New York, Basic Books, 1963; Philip Petit, The Concept of Structuralism, a Critical Analysis, Gill and Macmillan, Dublin, 1975. The literature is truly prodigious.

The American Noam Chomsky's epistemological structures or deep grammar of the human mind is related to French structuralism, but is of independent origin and has its own distinctive ethos, important for the understanding of the way the human mind functions in knowing.

Structuralism has now hit Biblical interpretation ~~exegesis~~ in a big way, and in French-speaking circles, ~~structuralism~~ of theology, Structural Exegesis has became the reigning fashion.[6]

Structuralism changes colour with every passing month. It is determined to find a unifying methodology for all knowledge. Its possibilities of success can be differently assessed by different people.

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6. See Daniel Patte, What is Structural Exegesis, Fortress Press, 1976.

d) The German-Language Debate. Here the debate is exceedingly rich and rewarding, though scientists themselves are ~~unaffected~~ seemingly unaffected by it. We cannot do justice to the debate in our short survey here.

If in the English-speaking world still the ideal is the unity of all scientific knowledge more or less in terms of the laws of (mechanistic) physics, the German tendency for a long time has been to seek such unity in terms of the historical method. Not only do we have to keep in mind the difference or nuance of meaning between *Science* in English or French and *Wissenschaft* in German or *Wetenschap* in Dutch. Ever since Droysen and Dilthey, historical understanding (*Verstehen*) has been the model of knowledge rather than scientific explanation (*Erklärung*). The subjective pole in all knowledge is thus not only acknowledged, but deemed central, without denying the objective pole (as later happened in ~~some~~ some forms of Existentialism). Husserl, Brentano and Meinong among others had effected a problem shift in developing Phenomenology which sought to become the Science of Sciences by seeking to see knowledge as a system of meanings in consciousness or eidetic essences. Schleiermacher and Heidegger had contributed in no small measure to making the subjective element both the starting point and the essential locus of all knowledge.

Today the debate is between Hans-Georg Gadamer and Jürgen Habermas. Gad *Truth and Method*[7] is the centerpiece of the discussio

7. *Wahrheit und Methode*, J C B Mohr. Tübingen English Tr. Sheed and Ward, London

He sees all knowledge as based on fore-knowledge. It is ~~on~~ from previous knowledge that the knower, scientific or other, projects possible pre-judgments or pre-judices on to reality, seeking confirmation in the latter. Gadamer sees our very ~~concept~~ prejudice against prejudice as a prejudice inherited from the Enlightenment which sought to avoid all pre-suppositions of dogma and authority in seeking a knowledge based on pure rationality. This is a quest that has failed. Prejudice is the basis of knowledge, and there is no knowledge without prejudice, though there can be bad prejudices unconfirmable by reality and better prejudices receiving higher confirmation. Scientific theories as well as historical understanding are based on apt prejudices.

The knowing subject has his own effective history (Wirkungsgeschichte) which determines the horizon of his prejudices and thus the horizon of his perception and understanding. This Wirkungsgeschichte is determined by one's cultural background, historical locus, and personal training as well as inherited language-structures created by particular societies. Even in historical understanding one does not step out of one's own horizon to identify oneself with the horizon and understanding of a contemporary observer or participant in an event. One simply reconstructs the horizon of the contemporary or participant, and without by any means leaving or laying aside one's own horizon, fuses the two horizons, thus constructing a new understanding of a past event which cannot be identical with that of the contemporary

or participant.

Jürgen Habermas[8] takes Gadamer to task for not taking sufficiently into account the interest of the knower as an element in his wirkungsgeschichte. The knower's class interests as well as his transcendent interest in seeking better and better prejudices are just as important as the evolutionary history which produced the knower's horizon.

Both Gadamer and Habermas recognize the three levels of knowledge in the physical sciences (Naturwissenschaften), the human sciences (Geisteswissenschaften) and the critical sciences (Ideologiekritik) like literary criticism or socio-politico-economic ideology.

The debate is far from resolved, but what emerges as an important point for us is the non-universality of the horizon of the knower which makes the notion of a non-subjective objectivity even more problematic.

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8. J. Habermas: Knowledge and Human Interest (Erkenntnis und Interesse), Boston, 1971; Theory and Practice, London, 1974; Communication and The Evolution of Society, Heinemann, 1979. See also the excellent discussion in Thomas McCarthy, The Critical Theory of Jürgen Habermas, Cambridge, (Hutchison)

:) The Official Marxist world.

Habermas, who is a post-Marxist who came out of the German Marxism of the Frankfurtschule, is criticized by official Marxism for being too academic and abstract, and fundamentally in error at the point of not adequately recognizing the epistemological value of labour and the relations of production. For Marxism, which still believes in the objectivity of a world "out there" independent of the subjective observer, and in the medieval principle of adaequatio rei et intellectus, sees scientific knowledge as a "reflection" in consciousness of an objective world in the process of a society's seeking to shape that objective world and to humanize it, thereby overcoming alienation between subject and object.

Marxism's great achievement is in the unification of all knowledge into a single integral whole, with the three laws of the dialectic (i.e. the mutual interpenetration of opposites, the negation of the negation, and the transformation of quantity into quality) as the basic foundation. Not that scientific knowledge can be deduced from the three laws, or that these laws can be successfully applied in detail at every level of reality. But philosophy or ideology remains inseparable from scientific knowledge and exists in dialectical relation to it. Philosophy itself is scientific knowledge abstracted at a very high level of generalization, spanning several

disciplines, and consequently exercises a controlling influence on scientific knowledge.

One must not entertain the idea that Marxist thinking on the problem of knowing is completely out-dated or static. There is a great deal of new thinking in the Soviet Academy of Sciences as well as in Polish and other Socialist academies of science. Most western evaluations of current Marxist thinking can be described as prejudices that do not find confirmation in reality.[9]

Literature in Western language is limited but not scanty. A whole new series of publications have recently come out of the ~~Moscow Ac~~ USSR Academy of Sciences, but out by Progress Publishers, Moscow. Attempts to understand certain dualities in present science are fascinating if not always successful - e.g. the corpuscular-undulatory characteristics of sub-atomic particles.

The quality of Marxist thought in analyzing the ways of knowing does not impress so much by its success in solving the basic epistemological questions (in fact here, it seems, is the basic weakness of Marxist philosophical thought), but rather in the construction of an aesthetically pleasing architectonic structure that integrates all knowledge.

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9. ~~Some~~ Among notable exceptions ~~are~~ is the American (non-Marxist) Loren Graham's Science and Philosophy in the Soviet Union, Vintage Books, New York, 1974, but recent developments have made the book a bit out of date. For ~~late~~ current Soviet literature in English, the best way to be up to date is to write for a catalogue to Progress Publishers, Moscow.

II Indian Thought – A Plethora of Perspectives

To western thought Can be ~~Appose~~ Contrasted with the Primal Vision of most of humanity still reflected in not too industrialized societies and also in some pockets of the counter-culture in the West. There is the whole Middle Eastern thought – especially ancient Assyrian and Egyptian, of which we know so little. There is Taoism which remains a dynamic force in at least one-fourth of mankind, especially in Chinese and related societies. Buddhism, in its various forms has different approaches to knowing.

In India itself, the culture has developed at least five major ways of knowing or looking at reality:

(a) the Vedic Paradigm, which belongs to the earliest documented level in Indian thought sees the Universe as a huge Cosmic egg in the process of hatching, but which process can be disrupted by human sin as well as sin by the Gods. It has to be held together by sacrifice, or self-giving which is what keeps it from going to pieces. This ritualistic-mythical perception of the universe and of a unity within which the knower stands, and which has to be sustained and maintained by the Conduct of free beings within it. It plays very little role in the current intellectual life of India, but has been re-stated in a relevant and interesting way by the Hispano-Indian Catholic Scholar Dr. Raymundo Panikkar.

b) The Secular Dualistic World-View Arising out of a reaction to the over-ritualization and clericalisation (a perennial danger for all sacramental views) of the Vedic view, the Sankhya view seeks to see all reality in terms of an interaction between Conscious and non-Consciousness (Puruša and Prakṛti). The Sankhya philosophy showed itself to be extremely dynamic, not only by constant changes within the system itself, but also by giving birth to very stringent systems of thinking and knowing. Logical philosophical systems like Tarka and Nyāya were inspired by it. Nearly all forms of Hinduism and Buddhism are something to the categories and perspectives of the Sankhya system. Both Consciousness and non-consciousness arise out of the single reality called the AVYAKTA (means the unclear or indistinct) and reality is a constant interplay between the Conscious and the non-Conscious. Out of the Indistinct arise the three basic qualities of Tamas (literally darkness), Rajas (literally dynamism) resplendent, shining forth, active, and Sattva (literally being, truth, unchanging reality). The purpose of all knowing is to move up the scale from torpid, sensuous instinct-driven darkness, to the shining and dynamic activism of light and from there to realised being.

) The Religious Dualistic view, similar in some ways to the western religious views is comparatively modern (13th century) in Indian thought, and may be a the marks of early contacts with western travellers and Semitic traders. Madhva, whose dualistic system calls itself Dvaita (literally dualism) sees God and universe as two distinct realities. It sees also ordinary sense-knowledge as real and not illusory. For him there can be no final external ~~validatory~~ validating authority for knowledge. It is our own internal perceiving centre (Sākshin) that is the final source of conviction, not any external authority or criterion of measurement or experiment. Dividing the universe into the conscious and the non-conscious, he gets three realities, Brahma (God), Jiva (Life or Soul or Conscious ness), and Jada (body or non-conscious reality). Knowledge has as its goal understanding the relation and the difference between these three realities, i.e. five sets of relations and differences: Brahma-Jiva (God-Soul), Brahma-Jada (God-non-conscious), Jiva-Jada (Soul-body ≠ or consciousness-matter), & Jiva-Jiva (between conscious beings) and Jada-Jada (between various non-conscious entities). Ultimate unification of all knowledge, however, comes through bhakti, or devout and self-giving worship.

d) The Vedantic Non-dual way. This is the dominant Indian view among Hindu intellectuals, most of them adhering to the absolute non-dualism (Kevalādvaita or ádvaita) of Sankara (8th century), only a minority professing qualified non-dualism (viśiṣṭadvaita) of Ramanuja (11th century). Vedanta makes the important distinction between parā-vidya (transcendent Knowledge), and aparā-vidya (non-transcendent Knowledge), corresponding to two levels of reality, i.e ultimate reality (paramārthika-satta) and practical every-day experience of reality (vyavaharika Satta). The three-fold difference of Knower, Known and Knowledge relates only to the second level, to which modern science belongs. In the ultimate or transcendent perception of reality, Knower, Known and Knowledge became integrated into one single reality in which there is no duality between self and world or self and God.

Non-transcendent knowledge, including scientific knowledge, in this perception, is valuable as a way-station on the path of knowledge, but the ultimate destination is parā-vidya or transcendent Knowledge which overcomes all duality. Therefore precise thinking and theoretical reflection can help. Especially helpful is the knowledge of knowledge itself; but when one knows reality by measuring it; in order to know the nature of that knowledge, one has to have some perception, not only of the knowing ~~process~~ measuring process, ~~but also~~ (a la Kant or phenomenology in the west), but also the nature of that which is measured (prameya), the nature the measuring-stick or method used (pramāṇa), and the nature of the measurer (pramāta). It is in the analysis of these that the limitations of non-transcendent knowledge (aparā-vidya) are revealed

This is a very valid insight in relation to contemporary science, which we accept without too ~~much~~ deep analysis, because it 'works' — works to gratify some of our desires.

The Buddhist Middle Way. Buddhism, ~~itself is~~ followed only by a very small minority (less than 1%) in India, was ~~once~~ for many centuries, a most vigorous intellectual and spiritual system in India. I would particularly commend one school within Asian Buddhism, the Middle Path or Mādhyamika philosophy. Its founder and most important thinker, Nāgarjuna, seems to me one of the most powerful thinkers the human race has produced, comparable to Plato or Aristotle, Sankara or Thomas Aquinas, Kant or Hegel. In contradistinction with, say, Heidegger, ~~Kumarajiva~~ Nagarjuna insists that the Conceptual approach to truth and our present kind of scientific approach to reality. He does it on a logical basis, calling in question our accepted notions of Causality, space and time, basic to all Conceptual understanding. Nāgarjuna would not say that things are like this or are not like this. Things do not come into being, or cease to exist; neither do they not come into being, nor do they not cease to exist. The positive statement and the negative statement are equally untrue or unfalse.

Such thinking is of course very frustrating to the neat binary western logic

of non-Contradiction and excluded middle to which the west claims to adhere.

But two concepts in Nagarjuna's thought - Reality as Śūnyata (Void) and its appearance as pratītya samutpāda (conditioned co-emergence) deserve special attention in the light of recent developments in Western science. The concept of Śūnyata (Śūnya means zero or non-being) does not mean that reality is non-existent; it affirms that concepts are not true reflections of reality and are not adequate guides to dealing with reality. The concept of pratītya-samutpāda insists that reality as it appears is neither real nor unreal, but an experience that arises under certain conditions within the knower and within the known

The questioning of the ultimate reality of the world perceived by our senses and dealt with in our science is a common characteristic of the Vedantic Māya doctrine, and of Buddhist Mādhyamika doctrine of Śūnyata. This should not be confused with Plato's two worlds - the cosmos noētos which is one, perfect, eternal and unchanging, and the ordinary world of particulars which is manifold, imperfect, temporal and changing. The Indian view may have somewhat similar intent to Plato's two worlds; but it is more radical. It does not say, as western popular over-simplifications often picture Māya or Śūnyata doctrines, simply that the world is illusion. What it says has some relation to the Biblical affirmation that the things open to our senses (ta blepomena) are only passing or for the time being (proskaira), while those not open to our senses (ta mē blepomena) are lasting or eternal (aiōnia). (2 Cor 4:18)

My purpose in setting forth a listing of five different Indian approaches to reality was only to exemplify other possible perspectives still unexamined by educated people in the ~~Western~~ so-called modern world. There are dozens of other possible perceptions and there is no guarantee at all that the scientific perception of the west has sufficient validation within itself to judge and condemn other perceptions. This is an exceedingly important point, and I think that the Cartesian arrogance of modern science which I regard not ~~as~~ only as unjustified but also as a major and destructive malady, can find some hope of healing only by being deeply exposed to these other cultural perceptions and the experiences which underlie them. I am also suggesting that the contribution of these other perceptions can not be limited to merely the application of science, but to a radical questioning of the assumptions on which modern science is based, and therefore, hopefully to a radical reorientation of future scientific development.

From my perspective it becomes increasingly clear that all scientific knowledge is a subject-object kind of knowledge that has a very meaningful function in this time-space universe of our existence and perception, but that it can only serve the true purpose of human existence when it moves forward in two directions at once. One direction is the social dimension becoming more closely integrated with the practice of science so that science and the technology based on it serves the truly human ends of justice, peace, human dignity and the unity of the human race. If I may say so without antagonising the scientific community, that community

is at present too sadly alienated from social and political-economic reality. The development required demands that our universities and schools integrate the study of the interaction between science and society into the training of not only scientists but of all educated people. The scientific enterprise cannot be analyzed as if it existed independently of society. Future research and training must devote at ~~least~~ least ten percent of ~~the~~ humanity's scientific resources to research and training in the understanding of how science and technology functions in society.

The second direction for the development of future science, I believe, should be towards transcending the subject-object kind of knowledge towards transcendent wisdom and meaning. The claims once advanced by modern science to ~~have~~ have access to impersonal, non-subjective, objective, proved knowledge, stand largely discredited. The import of developments in science in our century — ~~namely~~ including quantum mechanics and the Special Theory of Relativity, the uncertainty principle, the Michelson-Morley experiment, the Einstein-Podolski-Rosen paradox, Gödel's theorem — is to show up the highly problematic character of our earlier scientific certainty based on the observable regularities of newtonian mechanics which we once took to be the "immutable laws of nature", independent of human perception, universally valid and objective.

earlier scientific certainty based on the observable regularities of newtonian mechanics which were then regarded to be immutable "laws of nature" independent of human perception. Today it is more likely that the laws of newtonian mechanics ~~are~~ will be regarded as a special case within a much more complex universe which has other laws as the basic framework and newtonian mechanics ~~fulfil~~ becomes valid only within a given range of the spectrum of reality.

We have also come to a stage in modern physics where our theories are, recognized to be limited by the categories of language. We try to understand light or electrons as particles or waves, both concepts drawn from a communicative or mechanistic language. We find neither of them by itself adequate to describe the behaviour of light or electron. At least at the sub-atomic ~~last~~ level, we have to affirm: (a) that naive realism cannot account for the experimental data; (b) that we have no knowledge of how a particle behaves independently of our observation and measurement; (c) that there is no pictorial representation of the atomic world that is adequate, ~~and that~~ (d) that the usual notions of time, space and causality by which we understand reality in the ~~time~~ mechanistically conceived universe cannot be applied to the sub-atomic world; ~~and~~ (e) that the world is not a whole ~~of~~ material parts, but is

If all data are thus theory-laden and all properties which we ascribe to the "objective" world so observer-dependent[2]; if there is no one given model by which reality can be understood; if even the sub-atomic particles are not individuals with their separate identity but manifestations within a system which is more than the sum of its parts; if matter itself is composed of energy-waves or vibratory patterns in time, rather than of inert particles[3]; and if, as one interpretation of the uncertainty principle would have it, reality itself is non-objective, or at least conceivable in terms of alternate potentialities co-existing as probability waves, then our certainty of the given-ness of the world as we now experience it rests on an extremely questionable epistemological basis; we can take more seriously alternate views of reality like māya or śunyata for whatever cogent sense they can make. We can abandon our old superior and condescending characterisations of Oriental thought as world-and-life-denying while regarding our own thought as nobler and world-and-life-affirming.

The fundamental affirmation of Oriental thought can be put in one sentence: "any knowledge in which the knower, the known

2. N. R. Hanson, "The Dematerialization of Matter" in Ernan McMullin, ed. The Concept of Matter, Univ of Notre Dame Press, 1963. p. 579

3. I have in mind the Heisenberg interpretation, in ... of Heisenberg, Physics and Philosophy, New York,

and the knowledge remain separate is not true knowledge; and conversely, that alone is true knowledge where the subject, the object and their relation in terms of knowledge becomes a single unit." This is the essence of the Vedic, Upanishadic or Buddhist as well as Taoist vision of reality. And to this vision Christians as well as people trained in the ways of western science ought to pay greater attention than we have in the past.

III

Community, Tradition and Interest

Scientific research is a community enterprise, based on tradition, oriented by certain interests.

Our conception of the world is in need of revision; so is our conception of the knowing individual as autonomous subject.

No scientist starts his work from scratch, nor does he carry out that work and bring it to fruition in isolation from the scientific community. Whether in "ordinary science" or in "revolutionary" science, to use Kuhnian terms, the creative practising scientist has to take on trust most of the accepted past research of the scientific community, ~~on trust~~. He cannot himself go through all the experiments necessary to establish all the assumptions on which his own research is based. He inherits from the scientific community a vast body of knowledge, a way of doing research, and some paradigms within which previous work has been carried out. Every scientist is thus the inheritor of a tradition and is heavily dependent on that tradition.

It is not sufficient that his research yields sufficient knowledge for himself. He has to convince the scientific community about his work and its results. They are his judges and their acceptance of his work is crucial. He benefits from their advice and criticism not only in his work but also all along

The whole body of scientific knowledge can never be held in one individual mind. It is the whole scientific community who is both the custodian of tradition and the promoter and judge of creativity within that tradition. The failure to recognize the role of community and tradition in scientific work can distort our vision of science. ~~Scientific is conceived as absolute knowledge~~

The same is of course true also in religious knowledge – heavily dependent on community and tradition even in those case where it is dogmatically held that the individual's faith is independent of Church and Tradition. The Apostles themselves regarded the faith of the Church ~~which~~ as something which they had received and transmitted. (1 Cor 11:23; 15:1) No ~~fund~~ Fundamentalist can declare that Jesus Christ is Lord or that He is risen, without depending on the primary witness of the Apostles handed down from generation to generation in the Community of the Church. Non-recognition of tradition does not abolish tradition, either in science or in faith. The great ambition of the Western Enlightenment to dethrone tradition and replace it by reason has not proved worthy or capable of fulfilment. ~~tradition~~ human tradition ~~is~~ all traditions are equal

Equally important in the development of science is interest. Pure science, science as knowledge for its own sake, has become, even as an ideal impossible to achieve. Cultural and economic interests basically influence the choices of problems

and the financing of them;
for scientific research, less than 50% of modern science may be devoted to genuine human problems; most of it is oriented to military defense or offense, or to producing quick profit for the big Corporations.

In religion too power interests play such a large role as to obscure and distort its genuineness. The failure of religion to carry conviction is less due to the domination of the scientific world-view than to the betrayal of religion's own authenticity by extraneous interests of economic or political power, domination, prosperity, prestige and so on.

It is the task of Community and tradition to call back science as well as religion to its true and authentic identity. In the scientific community too, dogmatism and the play of interest distort the true identity of science and retard its true development. Perhaps the distraction in science is almost as bad as in religion, for it becomes impossible for the scientific community to liberate itself from the enslavement to military and Commercial interests, and to find funds and personnel for science to pursue genuine human interests

Perhaps the place where religion and science can cooperate is at this point - i.e. in calling both the religious Community and the scientific Community to reassert their authentic self-hood, and to seek to serve

[illegible] and

The Scientific Community is at present alienated from society in many parts of the world. The religious community is even more alienated, largely by its own fault, from the scientific community as well as from the human community in general which it claims to serve.

Communities live by tradition. Tradition becomes sterile when it becomes static, dogmatic and self-satisfied. Tradition, as classical Christianity conceives it, is a striving forward of a community, based on an awareness of the experiences which have shaped it, towards goals which it imperfectly perceives and partially achieves. Tradition cannot stop in its striving; but such striving, if it is to be truly liberating, must be based on a fearless and non-self-justifying self-understanding of communities, and a clearer and deeper insight into the goals which they set for themselves and others.

The play of interest, of desires we cannot master, but which drive us, distorts both Community and tradition. Religious communities and scientific communities have to help each other in understanding and mastering the play of these interests.

It is a fundamental insight of the Eastern Christian tradition that true growth in knowledge comes not primarily by greater conceptual clarity, but by the transformation of the being of the knower as the knower becomes freed from alienation and inauthenticity. Science and technology has their role to play in that liberation and transformation, but cannot by themselves achieve either.

IV. Overcoming Alienation and Recovering Authenticity
Some Conclusions

The self becomes inauthentic when it is alienated. Both scientific communities and religious communities today manifest many symptoms of this alienation and inauthenticity, which prevent it from rightly knowing reality and from being rightly related within reality.

Authenticity requires both identity and relation. Identity involves some distinctiveness or difference ~~but also freedom~~ from the rest of reality but also requires proper relations with that reality within which that distinctiveness can be maintained. Alienation affects both self-understanding (identity) and relation.

The overcoming of alienation demands changes in understanding and changes in relation. I submit that certain types of dualism which have played a large role in our understanding and relation need to be analyzed and overcome or corrected. I wish only to mention some examples here:

(1) Man and Nature dualism with which is connected the subject-object dualism where Man is subject and Nature object;

(2) Nature-Supernature dualism, appearing also as Nature-Grace dualism. The basic error is in the very conception of nature as an autonomous realm (whether created by God or self-existent) subsisting by its own laws where God does not

Constitutes
and is the realm of science;
intervene, while "supernature" is conceived as the realm of God's activity, the realm within which religion operates. ~~Creation-Redempt~~

(3) Creation - Redemption dualism: By placing a disjunction between the creation which was held to be autonomous and a finished act of God, and conceiving Incarnation and Redemption as an act of ~~foster~~ intervention, for which creation serves merely as back-drop and raw material or support-system, we have again separated revelation and reason, justified our lack of Christian "Concern about (and for) Science". If on the other hand we conceive creation as an ongoing act within which Redemption becomes a central event, then scientific activity itself can be seen as part of God's Creative action in which human beings are invited to participate.

One could mention many other dualisms — material-spiritual, God-world, Hebrew-Greek, Christian-non christian, vertical-horizon evangelical-liberal, personal-social, and so on. All of these can be overcome at a higher level of understanding and apprehension. Failure to do so will increase the alienation between Science and Religion and distort the reality of both.

The Scientific Community lives to help the religious community at this point. Theology is seeking to break out of its alienation by being concerned about socio-economic justice. It must go further to

understand the deep problems raised by science and by the reflection about science, and thus, together with Scientists, for a comprehensive meaning-structure for religious as well as scientific perception.

Let me conclude by reaffirming three things:

a) that the Scientific Community and the religious communities should cooperate in rediscovering their authentic existence and role in society through an analysis of their traditions, of how their activity or inactivity affects society, and through a more clear perception of their goals and purposes;

b) that all dualisms in perception and reflection are to be overcome by relating separated entities at a higher level;

c) that all activity, religious or scientific, (knowing, being and acting) should be oriented towards the unity of humanity in God, and with the rest of creation.

SCIENCE FOR SANE SOCIETIES

Ethical and Philosophical Issues raised by modern Science and Technology.

(Personal Reflections on the World Conference on Faith, Science and The Future - Cambridge, Mass - July 1979)

The book starts with some of the unresolved issues debated at the World Conference on Faith, Science and The Future, organized by the World Council of Churches, at Massachussetts Institute of Technology, Cambridge Mass, U. S. A. in July 1979. The author was Moderator of the Conference, as well as of its preparatory Committee. He will continue to chair its follow-up work also.

These personal reflections, which start with the more directly comprehensible ethical issues debated by the Conference, takes the analysis further in three areas, namely a) Science and the kind of Society in which Scientific and technological development takes place b) Philosophical reflections about Science, and c) the need for Science and Faith to collaborate in the formation of a new paradigm of reality in which both Science and Faith can find their proper place and greater possibilities of creative inter action and cooperation.

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SCIENCE FOR SANE SOCIETIES (Tentative Title)

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SCIENCE, TECHNOLOGY AND THE FUTURE OF HUMANITY.

Some Questions for Reflection.

(Dr. Paul Gregorios)

1. Modern science, and the technology based on it, are comparatively new in the history of humanity - only a few centuries old. Science had once to fight for survival against the unjust onslaughts of a dogmatic western religion. That period is now happily over. Science has now come of age, and can stand on its own, not seeking any protection or promotion from religious circles.

2. On the other hand, Science itself had been tempted, especially in the light of some of her more spectacular achievements of the ned of the last century, to claim certain dogmatic certainties for herself. But as our century draws to its close, dogmatic scientism becomes increasingly out-dated and unfashionable.

3. Today one notes at least four different attitudes to Science and Technology occupying the centre of the stage.

a) First comes the popular view about science and technology, a view which is a kind of hang-over from the hectic days of triumphaeistic scientism. This is the belief, widely held, that science and technologyare potentially capable of solving all the problems of mankind. This naive view is especially common in the developing countries of the world, where the wise use of modern science and technology is comparatively new, and the marvels of science and technology can still make a great impression on the minds of ordinary people. I think this view is still rather common in India.

b) On the opposite extreme, and almost totally irrational is the view of the Counter-culture Syndrome in advanced industrial societies. Theodore Roszak, for example (Where The Wasteland Ends, The Making of a Counter Culture)says: "Because science dominates the reality game of high industrial society, I am convinced that a hard critique of its Psychology now as everything to do with restoring our cultural health". (Wasteland, P.371) Acknowledging his debt to such contemporary thinkers as Abraham Maslow (Solution proposed: 'hierarchical integration' of many modes of knowing, including those of Tao and Zen as well as the scientific), Lewis Mumford (a science based on "an organic world-picture), Lancelot Law Whyte (integration

of art, ethics and natural philosophy within a 'science of form' Thomas Blackburn (integrate sense-experience, intuition and objectivity on a complementarity model), Arthur Koestler (anti-reductionist emphasis on wholes and systems), and others, Roszak charges that

> "science is far too narrowly grounded in the personality. It closes out too much experience and in this way drastically distorts what it studies" (Wasteland, P.372).

His view is that "science has been lionized out of all proportion by the necessities of urban-industrial life and by the political opportunism of the technocracy". Roszak's solution is the "rhapsodic intellect", in which science is wedded to mysticism and art to produce a resolution of consciousness which restores the "sacramental vision of nature" to Science. But this revolution

> "will happen, perversely and heretically at the fringes of our culture and work its way in toward the center. The Scientists, the guardians of single vision in urban-industrial society and the intellectual linch-pin of the technocracy, may be among the last to hear the news"(ibid.p.378)

c) A third type of view comes from English-speaking philosophers of science. Despite the wide divergence among them, there is growing consensus among Karl Popper and Thomas Kuhn, Paul Feyerabend and Stepehn Toulmin. While Popper argues for the autonomy of a "third world" of man-made ideas called scientific knowledge constantly in process of revision and evolution (Objective Knowledge: An Evolutionary Approach, OUP. 1972), Feyerabend argues for epistemological anarchism in science (Against Method, New Left Books, 1974). The second edition of Thomas Kuhn's Structure of Scientific Revolutions (with an added postscript) came out in 1970 (Chicago University Press) with his theory of paradigms further refined. Kuhn sees science as a 'way of seeing' through paradigms or picture-analogies, the paradigms themselves being in a process of constant revision and change, change not in accordance with any rational law, but lamost haphazardly, often by revolution, most of the time through battles between rival paradigms created by "congeries of specialists' communities" (See Imre Lakatos and Alan Musgrave, Ed., Criticism and the Growth of Knowledge. (p.253) Science is a system of theory choices, preference being for theories or paradigms with greater accuracy, scope, simplicity and fruitfulness. But these are not the only

....3

criteria for theory choice, which seems to demands also some free creativity, ie. an irrational element as well.

All these philosophers, however, agree on one point - Science is not proven knowledge; it is one way of seeing reality, quite a successful way, admittedly. But no thinking person would claim infallibility for science, nor would be give it any methodological monopoly over human knowledge. Science is a useful tool, it helps us to predict certain aspects of reality and therefore to control them. It may also help us partially to understand the nature of reality, but cannot give us an adequate picture of it. Such a modest evalution of science seems to be the one prevalent among most philosophers of science.

d) A fourth view of science is the one held in most socialist countries. It is difficult at the moment to document this view from primary sources, since western language sources are scanty. One of the best recent western studies in Loren R.Graham's Science and Philosophy in the Soviet Union.(Vintage Books, New York, 2nd ed.1971,584 pp) What we see here is a science-based natural philosophy. Marxist ideology itself claims to be the science of dialectical materialism, a scientific analysis of social reality. Graham calls "contemporary Soviet dialectical materialism"....."an impressive intellectual achievement"(p. 430). His praise, - and let me add that the American Professor Graham is no Marxist or Marxist sympathizer, - is rather fulsome:

> "In terms of universality and degree of development, the dialectical materialist explanation of nature has no competitors among modern systems of thought. Indeed, one would have to jump centuries, to the Aristotelian scheme of a natural order or to Cartesian mechanical philosophy, to find a system based on nature that could rival dialectical materialism in the refinement of its development and the wholeness of its fabric" (op.cit.p.430)

In other words the Marxist effort to integrate philosophy with science has no contemporary parallel in the West, where the two are kept in fairly watertight compartments even by many philosophers of science. One may question some of the assumptions of Sovient dialectical materialism but its rigorous effort to build an integral system that unites ideology, philosophy and science is more impressive than any other. But this also means that Eastern European scientists and philosophers of science do not share the uncertainty about science and

technology so characteristic of the contemporary western scientific thinkers. The west feels tempted to call the Soviet attitude 'Scientism' - the belief in the omni-competence of science. The Eastern European would deny that the epithet is merited. He would say that Marxism is the only ideology that integrates science in a larger framework that deals with all aspects of reality. It is a flexible ideology, which can give up a strict Laplacean type of determinism in the light of the insights of modern physics, but stricks on to causality despite indeterminacy at certain levels.

It is not a mere platitude to say that all these four views must contain some element of truth, though the degree of verity in each may be different. The third view which is the view of most thinking scientists outside the socialist world today, could be considered more modest and objective than the first or the second; but it does not raise the question of the role of science in the sum-total of human endeavour. It is that question that increasingly rises before us as western civilization itself goes through a measure of soul-searching and self-criticism.

The main point of this paper is to sharpen the articulation of this question and some related ones. Some of these questions are:

1. What degree of regularity and determinacy has to be assumed in reality in order to explain the fact that science has been 'successful'?

2. Does science provide objective knowledge of reality? Does the fact that at certain micro levels the observer is inescapably influencing the structure of the reality observed, lead to the conclusion that in all scientific knowledge pure objectivity is unattainable? What kind of objectivity does science provide? To what extent is the claim to objectivity questionable?

3. It has often been assumed that Science and Technology are by their very nature universal, which culture is by nature local. Can this view be sustained? How is modern science and science -based technology related to Western culture, and at what points do we need to beware of this relation in adapting modern science and technology to our needs in india? (This question is much wider than the issue of small, medium or appropriate technology).

4. On the one hand, it is charged that the classical Vedanta tradition which denies any ultimate significance to historical and material reality is inimical to the development of modern science and technology in India.

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On the other hand, it is being argued that the view of reality disclosed in modern physics is much closer to the world-view of Taoism, Buddhism and Hinduism than to West Asian religion like Judaism, Christianity and Islam (eg. Fritjof Capra, The Tao of Physics).

What is the truth in either of these assertions?

5. Science can promote certain values like integrity, honesty, clarity, etc. But most of the value questions facing society lie outside the purview of science as such. Some questions in scientific investigation are themselves not capable of scientific solutions. (eg.What degree of risk are we justified in taking in connection with experiments invovling genetic mutation, and creation of new bacteria strains?) How does society make sure that the work of the scientist is itself subject to values and norms decided upon by society?.

6. Development of the scientific consciousness has been alleged to be detrimental to the development of the faculties like intuitiveness, aesthetic sensitivity, vision of the whole of reality, etc. In there any truth in this allegation; Have we over-valued science and technology because of their phenomenal success in the recent past? How do we correct this imbalance, and devote greater attention to the development of the other faculties of the human person?

7. Science tells us very little about the quality of life. And it is being increasingly realized that a higher quality of life should be a permanent orientation in all economic and social planning. Can Science play any role in quantifying or 'functionalising' Quality of Life in such a way that it can be programmed into national planning? What indicators or parameters of Quality of Life are available for this purpose?

8. Research in Science and Technology usually finds funds mainly from two sources - defence establishments and large corporations. The interest of the former is in military technology and that of the latter in fairly quick profit. How can society ensure that research funds are available for scientific projects that genuinely promote human quality of life apart from defence utility or commercial profit?

9. Is it not a luxury for us in a country like India where 60% of our people still do not have a dignified human standard of living, to worry about the long-term cultural and spiritual consequences of adopting modern science and technology, since we have no other instrument available for removing that poverty? On the other hand, once you have taken the option to follow the road of science and technology and

urban-industrial civilization, can you really change direction in mid-course? Have we in India any other option than to follow this road and face the consequences when we get to the stage where the problems generated by the road tend nearly to over-whelm our humanity".

10. In terms of political options and their ideological underpinnings, do we really have an alternative, a third way, a way which is different from, and avoids the pitfalls of, market economy 'capitalism' of some sort and centrally planned marxist type of socialism? Is it simply the formula of non-alignment plus mixed economy? Is there an ideological road that is politically viable which takes seriously our own cultural heritage and makes the best use of science and technology? Or are we condemned to the fate of formulating our positions only in relation to certain western positions, ie. opposition to some partial acceptance of some, odd mixtures of different western positions, (mixed economy), qualifications of some of them (socialistic pattern of society), substitutes for Western concepts, often mostly in name (Sarvodaya, Janasakti)? Where is the forum where our scientific cultural minds and our spiritual leadership come together for a common creativity? Is our planning commission or our Education ministry the right place to lodge this concern? If not, do we need a new one, high-powered with creative strength, flexibility, time and resoruces?

SCIENTIFIC TEMPER

Time for a Resume before the Debate Resumes ?

(Paul Gregorios)

Why don't people give credit where it is due? If Ashis Nandy had not hit back in horrid overstatement at the Scientist's Manifesto (Statement on Scientific Temper) who besides a few connoisseurs would have paid any attention to it?

The debate has now gone on for full six months, a resume of the discussion so far is overdue before we go much farther. Let us start with Prof.K.V.Subbaram (Mainstream Jan 16,1982) who stated that Ashis Nandy obviously missed the main point of the Statement on Scientific Temper (SST). This seems true. The statement was directed against a phenomenon that frightens many thinking people - the growth of irrationality or retreat from reason, manifested in the recrudescence and popularity of religious practices (superstitions and bizarre rituals) incompatible with a rational world-view. And the consequence is that with the world's third largest trained man-power in Science and Technology we are unable to solve the basic problems of the Indian people - mainly poverty, inequality, ignorance, ill-health, and general backwardness, with a tendency to glorify the past by creating a false one. The authors and signatories of SST argue that all of us, not just scientists, but including teachers and media people, should undertake a rational scientific analysis of the social barriers that have to be broken in order to move ahead.

If that is the main thesis of the SST, then Ashis Nandy's powerful invective has hardly scratched its surface. Nor does the effort of Baudhayan Chattopadhyaya and Rajendra Prasad to castigate the SST and the Counter Statement on Humanistic Temper on purely ideological grounds carry much conviction.

Apart from intemperate language Ashis Nandy makes two points:

a) human dignity and welfare are more important than

the scientific temper in itself;

b) any evaluation of the scientific temper must depend on the criterion of how it contributes to human dignity and welfare.

I do not see how the authors of the SST can quarrel with that either.

Of course the SST does not say that the Scientific Temper will solve all human problems and will promote human dignity and welfare. But it does take the view that it is the prevalence of superstition, bizarre ritual and obscurantist social customs in an atmosphere of conformity, credulity and unquestioning obedience to authority, that constitutes the main obstacle to the advance of the scientific temper. The statement makes a case for such a view by arguing that "obscurantism and irrationalism practised by a hierarchy of authorities has the predictable effect of reinforcing retreat from reason". And so it places us before a choice: " We either overcome the obstacle or we shall be overcome by unreason and dark reaction".

Are those the real alternatives? The SST has not convincingly shown that the absence of or retreat from rationality is our main problem, endangering our very survival. It simply presupposes that position. And here, it seems, is where the issue has to be joined. Ashis Nandy argues

a) that science itself is not as objective or rational an exercise as it may first appear;

b) that science does not in fact exist in a pure state, but only as an aspect of a society's approach to life and as a historical development;

and c) that in the world today, the scientific enterprise has become a major instrument of oppression and the victims have a legitimate right to resist its triumphalistic onslaught.

Positions (a) and (b) have to be conceded without much argument. On point (c), however, the issues have to be more carefully formulated. Let us try to put down some affirmations which can then be argued out if necessary:

a) One cannot compare "pure" science and corrupt religion. The religious enterprise as well as the scientific enterprise has to be taken in the wholeness of its historical manifestation, and only afterwards can one separate pure religion or pure science.

b) There is no debate about the negative aspects of the religious record or about the positive aspects of the record of the scientific enterprise. What the SST fails to do is to make any reference to the positive achievements of religion or to the negative record of science.

c) The SST must concede to Ashis Nandy his charge about the complicity of science in the horror record of our own century (the century of science): ie. Nazi concentration camps, Hiroshima, Nagasaki, Stalin's Siberian camps, Vietnam, Cambodia and so on. Science and scientists are answerable for their complicity.

d) The authors of SST should answer the charge that science too can be authoritarian - it matters not that it is a corrupt science that becomes so; for in religion too only corrupt religion leads to authoritarianism.

e) The authors of the SST must answer the claim that others have just as much right to criticise science as science has right to criticise non-scientific activities and pursuits.

f) The charge that science is today prisoner - to the military establishments which breed violence and destruction, to the military contractors bent on making a fast buck and to Transnational Corporations which make profit and power their primary principles.

g) The most devastating charge is that the Scientific Temper can make human mind arid, one-dimensional, neglectful of the most cherished values of humankind.

The debate should continue and perhaps the Nehru Centre

should organise a small meeting where ipposing points of view can struggle to emerge in an improved draft which then can be the basis for a national debate. To say this, is of course, to express one's high appredation of both the original statement and of its criticisms.

The Religion of the Scientist

Some Questions to Science

(Paul Gregorios)

Steven Weinberg's The First Three Minutes* does not claim to give the scientific view of the origin of the universe. The sub-title speaks only of "A Modern View of the Origin of the Universe". But Steven Weinberg is a professional Harvard scientist of fairly high reputation, a particle physicist, not an astronomer, a regular contributor to the Physical Review; a researcher at the Smithsonian Astrophysical Observatory.

It is not a scientific book; it is not written for the scientists; in fact Weinberg states precisely the type of reader he has in mind: "I have written for one who is willing to puzzle through some detailed arguments, but who is not at home in either mathematics or physics". It is thus meant for the intelligent general reader.

Aye, there is the rub. It is a scientist writing for the general public. If he were writing for the scientific community, he would not only be more technical, but also more rigorous. And he is trying to convince the intelligent reader that science can now provide a supportable hypothesis about the origin of the universe. Of course, that is all that science ever does provide supportable hypotheses, and test them.

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*Basic Books, Bantam Edition, New York, 1979, 178 pp

An Isaac Asimov citation on the front cover of my paperback edition describes the book as "the first book to put the details of the origin of the Universe within the grasp of the general reader". That gives the impression, at least to the general reader, that it is popular science that is being dished out. T.D. Lee, "Nobel Laureate in Physics", says on the back cover: "a most remarkable achievem ment.... presented with clarity and great scientific accuracy".

Besides, at the end of the book, there is an elaborate "Mathematical Supplement", which gives the impression of providing the scientific basis for the popular presentation.

The book deals with "the early universe - and in particular with the new understanding of the early universe that has grown out of the discovery of cosmic micro-wave radiation background in 1965"

Now & what the general reader often gets from such a book is the vague belief that science or scientists can now explain how the universe came to be, and as a corollary, that religions are generally and often absurdly mistaken in their views on the subject.

The "scientific view" thus is that at the first 1/100 of a second after the "big bang" the universe had a temperature of 10^{11} (1 followed by eleven zeroes) degrees centigrade, at which temperature no gas or liquid or solid can exist - only "elementary particles" - mainly electrons and positrons, in about equal numbers - with some neutrinos and photons, both of zero mass and zero electrical charge, being continually created and dying out after a brief life. There was some "contamination" of heavier particles - protons and neutrons - at the rate of 1 heavy particle to 1 billion light particles. Then the cooling and the condensation of matter and all that - as in the "standard model".

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But what about 1/100 second before the cosmic soup at 10^{11} centigrade began to cool ? Well, Weinberg promises something in the introduction: "We will also try to look a little way into an era that is still clothed in mystery - the first hundredth of a second, and what went before". Well, Science does seems to know practically everything, just may be a little bit more to be found out, otherwise we are already there - at omniscience through Science, are we not ? We get the answer in chapter VII.

There was a universe of "infinite energy density" and "infinite temperature" before it banged - composed of quarks and antiquarks, leptons and antileptons, and of course photons, "all moving essentially as free particles". Each particle, whether heavy or light had its own black-body radiation. This was the situation in the first 1/100 second of creation (assuming of course that the quark theory will find sufficient empirical evidence in the future) at our crucial temperature of 10^{11} degrees centigrade. But there has been a "phase change" just 1/100 seconds earlier. Just as H_2O obeys different laws in its three different phases - i.e. steam (gas), water (liquid), ice (solid), the universe had a phase change, just as it cooled down from the critical minimum of say 3000 million million degrees (3×10^{15} degrees Kelvin). Previously everything was non-expanding and infinitely condensed - the whole universe probably being about the size of one of our present particles, or conversely, each particle about the same size as the present universe ! (p. 136) But actually nothing we can observe today depends on the history of the universe before the "phase change". We cannot find out whether the pre-bang universe was isotropic and homogeneous, or any such detail. Says Weinberg:

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"One possibility is that there never really was a state of infinite density. The present expansion of the universe may have begun at the end of a previous age of contraction, when the density of the universe had reached some very high but ~~finite~~ finite value". (p.138)

and again:

" .... although we do not know that it is true, it is at least logically possible that there was a beginning, and that time itself has no meaning before that moment". (ibid)

Weinberg becomes modest at this point:

" We may get used to the idea of an absolute zero of time (on the analogy of the absolute zero of temperature ~~at~~ i.e. - 273.16°C, when there is no temperature at all) - a moment in the past beyond which it is in principle impossible to trace any chain of cause and effect. The question is open, and may always remain open". (p.139).

Now Weinberg comes at the end of his book to some conclusions which sound strangely familiar to those of us acquainted with a large number of religious traditions - the Pralaya theory of the Hindus, just to cite one example. The Upaniṣads and the Brahma-sūtras have so many references to this concept. In Sri Śankara's commentary on the Brahmasūtras, the concept of pralaya (deluge) (I 1.2, II 1:1,8, 10, II: 3:14, 15,17, IV: 2:1, 15,16) and related terms like pralayakala (the time of the deluge), II: 2:12), pralayakrama (the order of the deluge, II 3.14) pralayaprabhava (the happening of the deluge, I:3:30) pralayaprabhava prasanga (the declaration of the happening of the deluge II:2:14) pralayaprabhava śravana (the hearing of the happening of the deluge, I:3:30), Pralayaprasanga (declaration of the deluge I:4:22) pralayaprasiddhyartha the spread of the news about the deluge II: 2:12), pralayasāmānya (IV: 2:16, general deluge or deluge-like) occur many times.

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Deluge is a poor translation of the word pralaya. The basic meaning seems to be dissolution (laya) into its original state by melting away. The classical Hindu conception is that the universe as we know it is a process of combining forces or qualities (gunas) which in their various combinations produce the changing reality of the time-world; we experience it in a particular way, because there are forces or qualities in the universe as well as in our own equipment (we being part of the universe now) which obscure the true nature of ourselves and the universe.

The sophisticated Hindu would say that this "phase change" of reality which we are now experiencing in time and space (and with which science primarily deals) is not the true nature of either ourselves or of the universe we experience. The original reality, that which existed before the phase change, before the first 1/100 second, is our true nature, and to realise and experience this true nature of ourselves and the universe is the ultimate goal of humanity.

Weinberg says:

> "Men and women are not content to comfort themselves with tales of gods and giants, or to confine their thoughts to the daily affairs of life; they also build telescopes and satellites and accelerators, and sit at their desks for endless hours working out the meaning of the data they gather. The effort to understand the universe is one of the very few things that lifts human life a little above the level of farce, and gives it some of the grace of tragedy" (p. 144)

Now to me who am not a scientist, that sounds more like a particular religious attitude than a scientific attitude. I respect this heroic, tragic, religious stance of the scientist who finds some meaning in his activity. But this is a particular religious attitude, and should not be confused with science. The religion of the scientist, if it is noble, should be respected as much as ~~my~~ any other religion.

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But the scientist himself should be aware that this attitude does not as yet belong to the 'essence' of science.

Neither does the attitude of many scientists towards religion belong to science. Weinberg begins his book by an account of the origin of the universe as explained in the Younger Edda, a 13th century compiled Norse or Icelandic myth. He feels very superior to the Norse mythical conception in which he sees nothing that is not ridiculous. The implied assumption is that all religious views about such matters are equally absurd.

Here is my modest question to my scientist friends. Why don't you recognize that myths are not science, that they don't speak the same language ? Why demand that religious language should imitate scientific language ? Is it not better to recognize that some scientifically "mistaken" religious conceptions of the universe have given better orientations for humanity relating itself to surrounding reality ? Why don't scientists speak about some of the most ridiculous "scientific" ~~speak-about-some-of-the-most~~ conceptions of 12th century at the same time as they lampoon a 12th century Norse myth ? Why don't they make a deeper study of the religious perspectives like Einstein and Oppenheimer did, study which probably helped them in forming more relevant scientific hypotheses ?

In India, why don't scientists try to explain their understanding of the universe to a group of Hindu, Muslim, Buddhist and Christian philosophers and listen to what they have to say ? It may not turn out to be as futile as one may think, provided of course there is competence, astuteness and openness on both sides.
